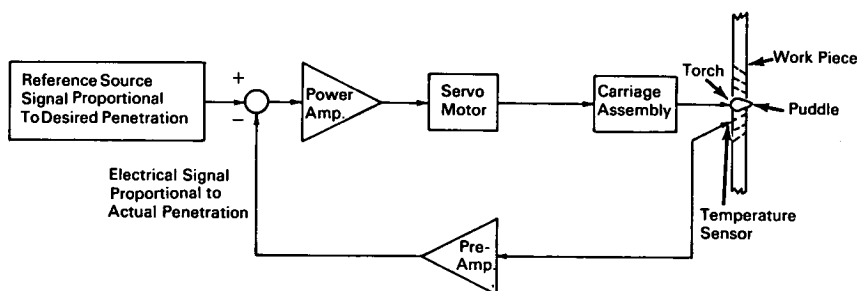


NASA TECH BRIEF



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System Maintains Constant Penetration During Fusion Welding



The problem:

In a typical fusion welding process, accurate control of voltage, current, and speed to compensate for minor variations in joint fitup, plate thickness, and shield characteristics has depended on the human operator as prime monitor in the feedback loop. A servo system is needed that will sense such variations and adjust the control parameters to compensate for them.

The solution:

On the assumption that a correlation exists between uniform weld penetration and the temperature gradients occurring in the vicinity of the molten puddle, a system has been developed to sense direct weld properties completely from the arc side and by means of feedback to a servo, make necessary adjustments to travel speed and weld current.

How it's done:

The system sensor consists of a single thermocouple wire of constantan in sliding contact with the aluminum workpiece at a fixed distance from the weld area. This sensor is connected to a servo control system as shown in the diagram.

When the output of the thermocouple equals the reference voltage, the output of the preamplifier is zero, no signal reaches the power amplifier and the

two phase servo motor is held at null position. If workpiece temperature at the thermocouple point of contact increases, thermocouple output voltage increases, the preamplifier supplies an input voltage to the power amplifier whose output causes the servo motor to turn. Through a magnetic clutch, the servo motor drives an electrode travel speed potentiometer (not shown) in the direction required to increase the travel speed. This results in a temperature reduction in the workpiece at the thermocouple contact point, reducing thermocouple output and effecting a return to system equilibrium. If workpiece temperature decreases at the thermocouple contact point, opposite polarity voltage is fed to the servo motor to turn it in the opposite direction and reduce carriage speed until system equilibrium is again effected.

Notes:

1. Because the workpiece forms one half of the thermocouple junction, radiated torch interference is eliminated and the response is essentially instantaneous.
2. Tests with aluminum plates both chemically cleaned and not cleaned showed no effect from oxide films on the workpiece surface when using the single wire technique.

(continued overleaf)

3. Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B67-10091

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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